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CONDENSED ONE-PAGE COST ESTIMATES FOR WASTEWATER TREATMENT

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Environmental Protection Agency
Cincinnati, Ohio

November 1970

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U. S. ENVIRONMENTAL PROTECTION AGENCY
Office of Research and Monitoring
Advanced Waste Treatment Research Laboratory
Cincinnati, Ohio

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Construction cost, amortization cost, operation and maintenance cost, and total treatment cost were calculated for various wastewater treatment processes at volume flows of 1, 7.5, 10 and 100 mgd. The results appear in Tables 1 through 4.

The construction and operation and maintenance costs for the primary sedimentation and activated sludge processes were taken from curves in the report, "Cost of Conventional and Advanced Treatment of Wastewaters." The same costs for the other processes (except chlorination) were taken from curves in the report, "Cost and Performance Estimates for Tertiary Wastewater Treating Processes." The costs for chlorination were obtained using curves supplied by Black and Veatch. For the chlorination cost calculations, it was assumed that a 10 mgd plant uses 8 ppm of chlorine 100% of the time (124 tons/year) and has a 14,000 cubic feet contact basin. The costs for the 1, 7.5 and 100 mgd chlorination processes were obtained by scaling the 10 mgd parameters.

The costs for single stage lime clarification were obtained using the cost curve for the two stage lime clarification process. Recalcination construction and operation and maintenance costs were the same for both. Single stage construction cost was obtained at half the volume flow for the two stage process. Single stage operation and maintenance cost was taken as half of the cost obtained at half the volume flow for the two stage process.

All construction costs were adjusted to January 1970 dollars using the construction cost index; operation and maintenance costs were adjusted to January 1970 dollars using the consumer price index. Amortization costs were calculated based on 25 years at 6% interest.

Graphs of construction costs and total treatment costs versus flow for the various processes are given in Figures 1 through 3.

Ten additional tables of various cost and bond indexes are also provided, so that the cost figures given in this report can be updated.

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COST ESTIMATES FOR WASTEWATER TREATMENT, NATIONAL AVERAGE, JANUARY, 1970, 1 mgd DESIGN CAPACITY

PROCESSES USED	Construction Cost, millions of dollars	Level Debt Service ¢/1000 gal, 25 yr, 6%	Operating and Maintenance, ¢/1000 gal	Total Treatment Cost ¢/1000 gal influent	ESTIMATED CONTAMINANT REMOVAL, PERCENT								
					5-day BOD* COD**	35*	88*	95*	97*	97*	97*	98**	98**
					Phosphorus	10	25	35	92	92	92	95	98
					Nitrogen	0	0	0	0	0	85	85	85
Primary Sedimentation and Sludge Disposal	.40	8.7	5.0	13.7		■							
Primary, Activated Sludge, and Sludge Disposal	.64	13.6	9.7	23.3			■	■	■	■	■	■	■
Microscreening	.04	.8	.6	1.4				■					
Single Stage Lime Clarification	.30	6.4	10.7	17.1					■		■	■	
Two Stage Lime Clarification	.36	7.6	13.3	20.9						■			■
Ammonia Stripping and Recarbonation, (summer only)	.10	2.2	4.8	7.0							■	■	■
Multi-media Filtration	.10	2.2	4.6	6.8								■	■
Granular Carbon Adsorption, 40 min contact	.40	8.6	23.7	32.3								■	■
Chlorination, 8 mg/l	.03	.7	1.4	2.1			■	■	■	■	■	■	■
Total Treatment Cost cents/1000 gal influent						13.7	25.4	26.8	42.5	46.3	49.5	88.6	92.4

TABLE I

COST ESTIMATES FOR WASTEWATER TREATMENT, NATIONAL AVERAGE, JANUARY, 1970, 7.5 mgd DESIGN CAPACITY

PROCESSES USED	Construction Cost, millions of dollars	Level Debt Service ¢/1000 gal, 25 yr, 6%	Operating and Maintenance, ¢/1000 gal	Total Treatment Cost ¢/1000 gal influent	ESTIMATED CONTAMINANT REMOVAL, PERCENT							
					5-day BOD* COD**	35*	88*	95*	97*	97*	97*	98**	98**
					Phosphorus	10	25	35	92	92	92	95	98
					Nitrogen	0	0	0	0	0	85	85	85
Primary Sedimentation and Sludge Disposal	1.64	4.7	3.5	8.2									
Primary, Activated Sludge, and Sludge Disposal	2.95	8.4	6.1	14.5									
Microscreening	.20	.6	.6	1.2									
Single Stage Lime Clarification	.95	2.7	4.9	7.6									
Two Stage Lime Clarification	1.20	3.4	6.0	9.4									
Ammonia Stripping and Recarbonation, (summer only)	.60	1.7	2.6	4.3									
Multi-media Filtration	.39	1.1	2.2	3.3									
Granular Carbon Adsorption, 40 min contact	1.43	4.1	8.5	12.6									
Chlorination, 8 mg/l	0.7	.2	.7	.9									
Total Treatment Cost cents/1000 gal influent						8.2	15.4	16.6	23.0	24.8	27.3	43.2	45.0

TABLE 2

COST ESTIMATES FOR WASTEWATER TREATMENT, NATIONAL AVERAGE, JANUARY, 1970, 10 mgd DESIGN CAPACITY

PROCESSES USED	Construction Cost, millions of dollars	Level Debt Service ¢/1000 gal, 25 yr, 6%	Operating and Maintenance, ¢/1000 gal	Total Treatment Cost ¢/1000 gal influent	ESTIMATED CONTAMINANT REMOVAL, PERCENT							
					5-day BOD* COD**	35*	88*	95*	97*	97*	97*	98**	98**
					Phosphorus	10	25	35	92	92	92	95	98
					Nitrogen	0	0	0	0	0	85	85	85
Primary Sedimentation and Sludge Disposal	2.02	4.3	3.4	7.7									
Primary, Activated Sludge, and Sludge Disposal	3.70	7.9	5.6	13.5									
Microscreening	.27	.6	.5	1.1									
Single Stage Lime Clarification	1.13	2.4	4.5	6.9									
Two Stage Lime Clarification	1.44	3.1	5.3	8.4									
Ammonia Stripping and Recarbonation, (summer only)	.78	1.7	2.3	4.0									
Multi-media Filtration	.47	1.0	2.0	3.0									
Granular Carbon Adsorption, 40 min contact	1.70	3.6	7.2	10.8									
Chlorination, 8 mg/l	.08	.2	.6	.8									
Total Treatment Cost cents/1000 gal influent						7.7	14.3	15.4	21.2	22.7	25.2	39.0	40.5

TABLE 3

COST ESTIMATES FOR WASTEWATER TREATMENT, NATIONAL AVERAGE, JANUARY, 1970, 100 mgd DESIGN CAPACITY

PROCESSES USED	Construction Cost, millions of dollars	Level Debt Service ¢/1000 gal, 25 yr, 6%	Operating and Maintenance, ¢/1000 gal	Total Treatment Cost ¢/1000 gal influent	ESTIMATED CONTAMINANT REMOVAL, PERCENT							
					5-day BOD* COD**	35*	88*	95*	97*	97*	97*	98**	98**
					Phosphorus	10	25	35	92	92	92	95	98
					Nitrogen	0	0	0	0	0	85	85	85
Primary Sedimentation and Sludge Disposal	10.28	2.2	2.2	4.4									
Primary, Activated Sludge, and Sludge Disposal	23.11	5.0	3.2	8.2									
Microscreening	2.07	.4	.5	.9									
Single Stage Lime Clarification	5.04	1.1	2.6	3.7									
Two Stage Lime Clarification	7.21	1.6	3.4	5.0									
Ammonia Stripping and Recarbonation, (summer only)	6.25	1.3	1.7	3.0									
Multi-media Filtration	2.12	.5	.9	1.4									
Granular Carbon Adsorption, 40 min contact	12.19	2.6	4.6	7.2									
Chlorination, 8 mg/l	.31	.1	.3	.4									
Total Treatment Cost cents/1000 gal influent						4.4	8.6	9.5	12.3	13.6	15.3	23.9	25.2

TABLE 4

EXPERIENCED COST FOR WASTEWATER TREATMENT AT SOUTH TAHOE PUBLIC UTILITY DISTRICT, CAL 7.5 mgd Design Capacity

EPA STP Index = 136.2 (1969) PROCESSES USED	Capital Cost, millions of dollars	Level Debt Service, ¢/1000 gallons, 6% - 25 yr.	Operating and Maintenance Cost, ¢/1000 gallons	Total Treatment Cost ¢/1000 gal influent	OBSERVED CONTAMINANT REMOVAL, PERCENT								
					5-day BOD* COD**		96.4**						
					Phosphorous		99.1						
					Nitrogen		60						
Primary Sedimentation	0.69	1.97	1.25	3.22		■	■						
Activated Sludge Process	1.25	3.57	3.36	6.93		■	■						
Organic Sludge Disposal	0.58	1.66	5.62	7.28		■	■						
Chlorination	.009	.026	0.22	.246		■	■						
Lime Clarification	.953	2.72	7.0	9.72			■						
Ammonia Stripping	.327	.934	1.0	1.93			■						
Recarbonation	.162	.463	.44	.903			■						
Filtration	.705	2.01	2.33	4.34			■						
Carbon Adsorption	.849	2.43	3.29	5.72			■						
Total Treatment Cost cents/1000 gal influent						17.68	40.3						

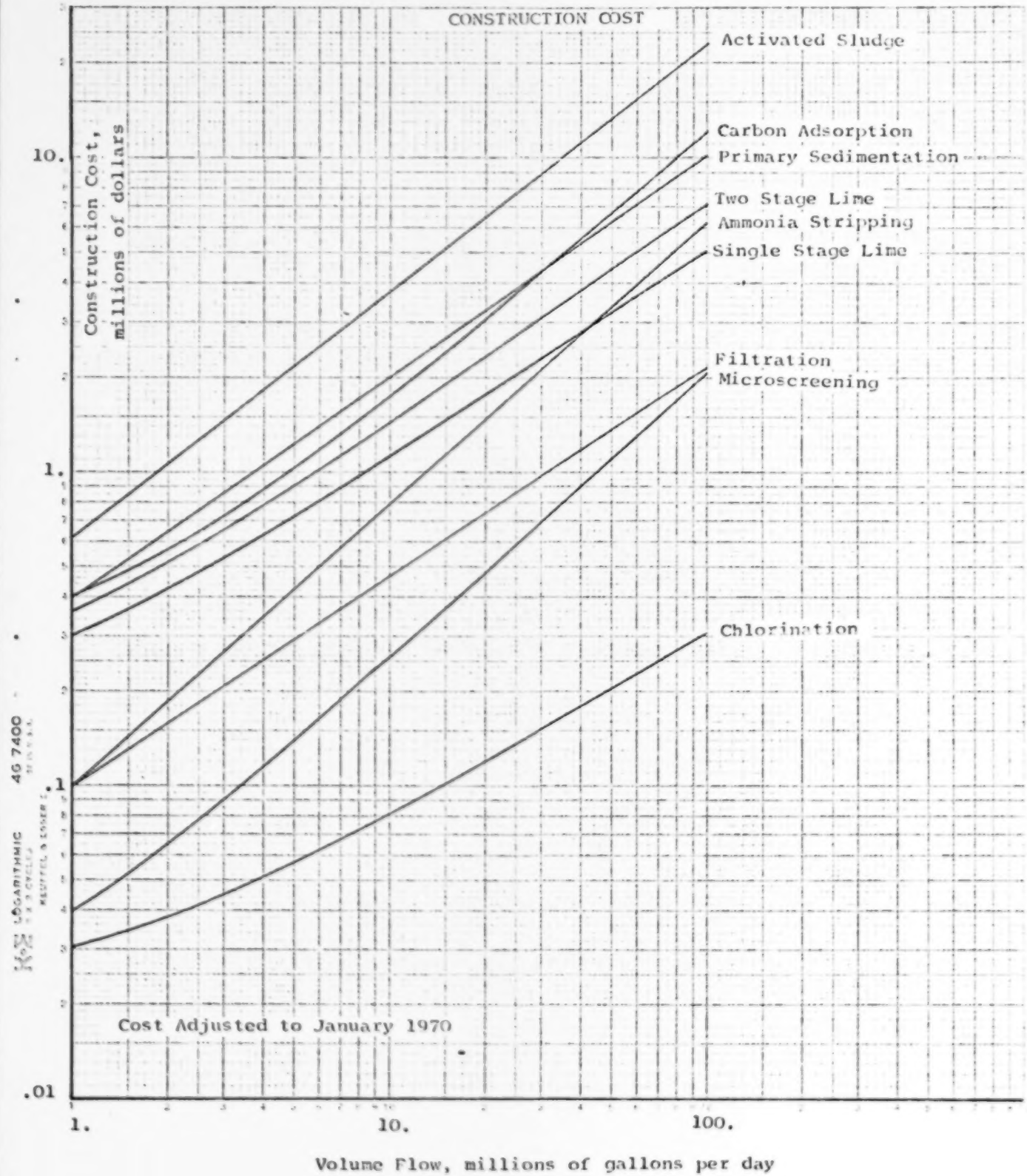
CONSTRUCTION COST
Construction Cost, millions of dollars
Activated Sludge
Carbon Adsorption
Primary Sedimentation
Two Stage Lime
Ammonia Stripping
Single Stage Lime
Filtration
Microscreening
Chlorination
10.
1.
.1
.01
Cost Adjusted to January 1970
1.
10.
100.
Volume Flow, millions of gallons per day

FIGURE 1

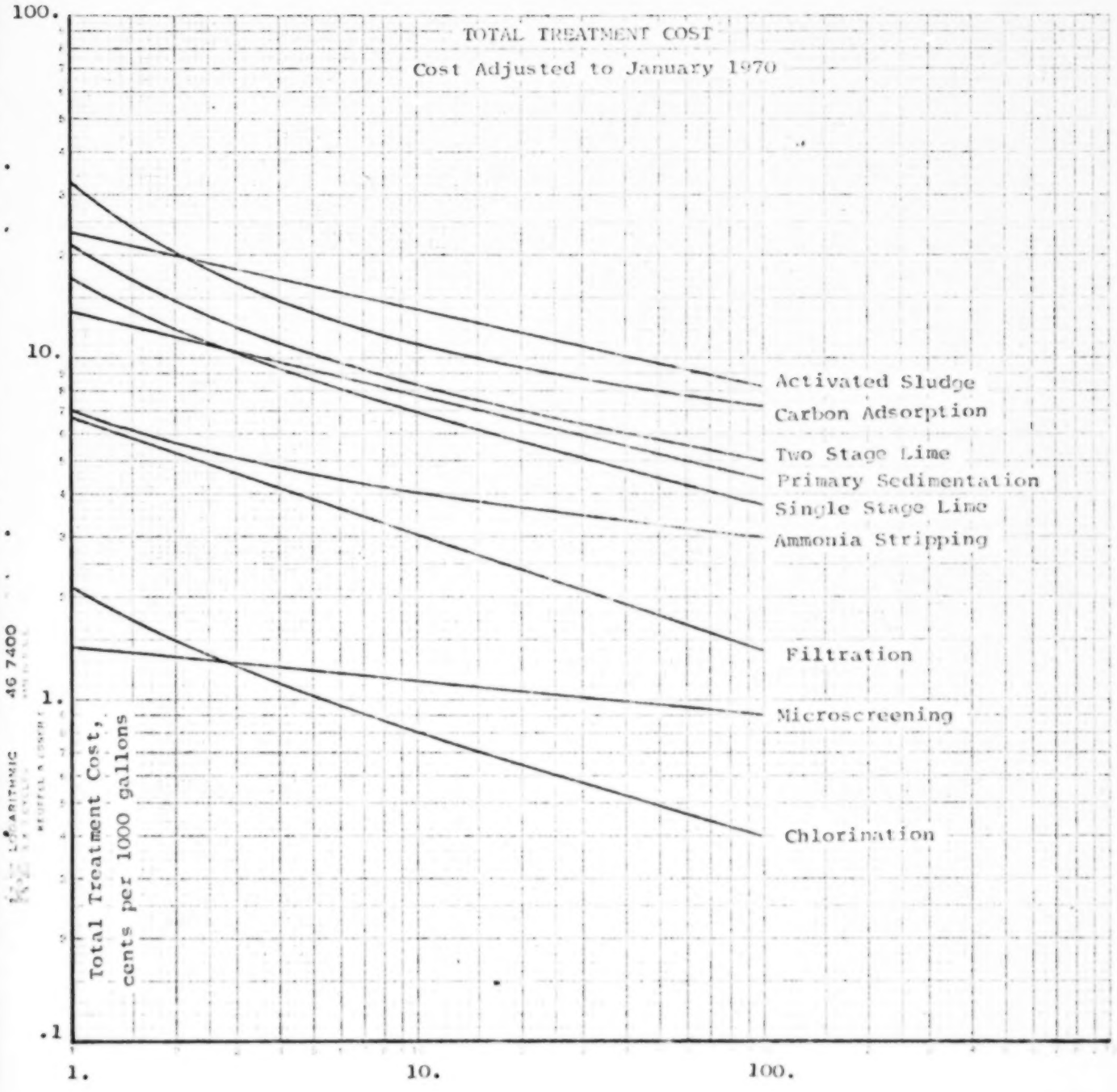
TOTAL TREATMENT COST
Cost Adjusted to January 1970
100.
10.
1.
.1
1.
10.
100.
Activated Sludge
Carbon Adsorption
Two Stage Lime
Primary Sedimentation
Single Stage Line
Ammonia Stripping
Filtration
Microscreening
Chlorination
Total Treatment Cost, cents per 1000 gallons
Volume Flow, millions of gallons per day

FIGURE 2

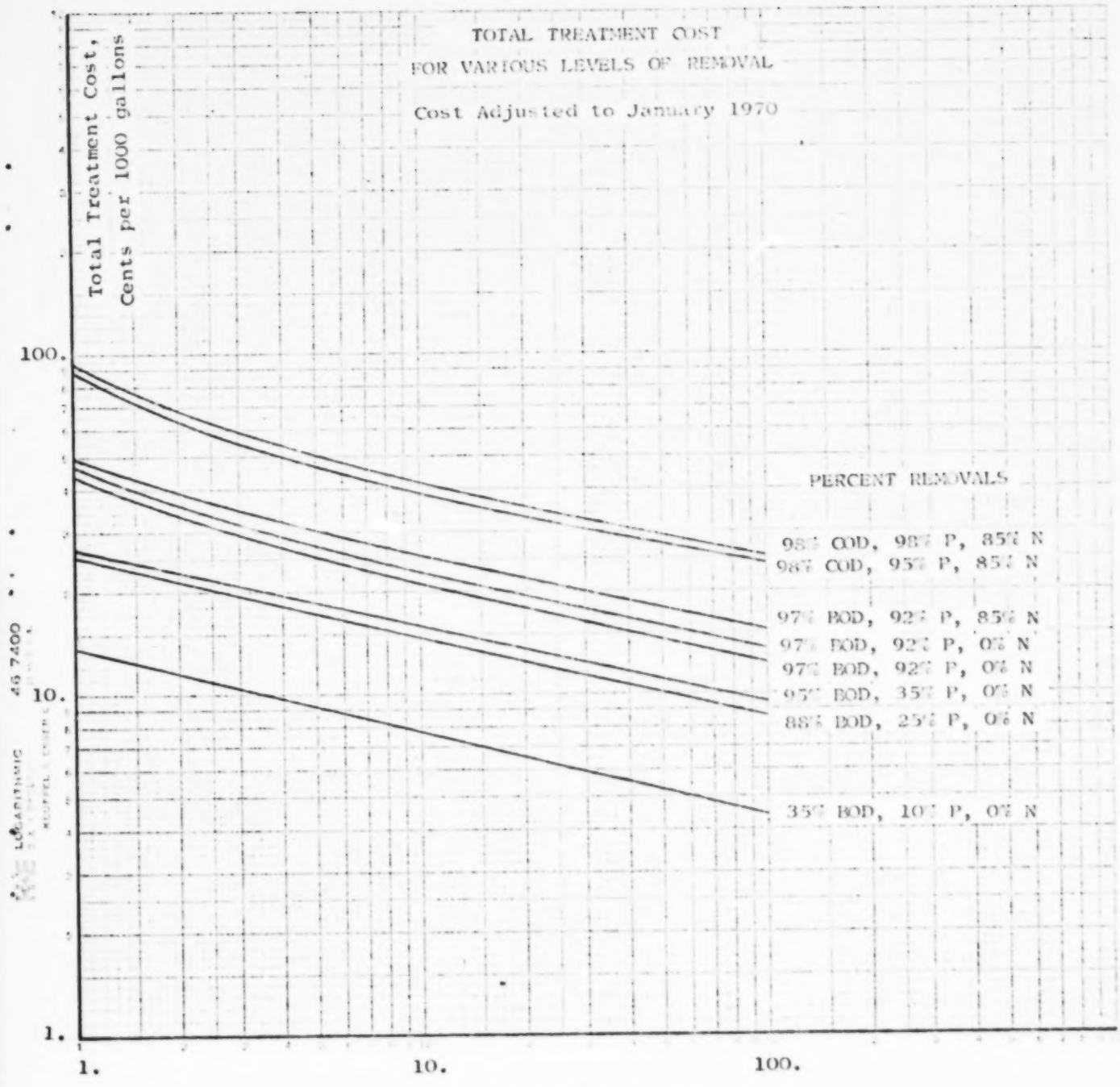
TOTAL TREATMENT COST
FOR VARIOUS LEVELS OF REMOVAL
Cost Adjusted to January 1970
Total Treatment Cost, Cents per 1000 gallons
100.
10.
1.
PERCENT REMOVALS
98% COD, 98% P, 85% N
98% COD, 95% P, 85% N
97% BOD, 92% P, 85% N
97% BOD, 92% P, 0% N
97% BOD, 92% P, 0% N
95% BOD, 35% P, 0% N
88% BOD, 25% P, 0% N
35% BOD, 10% P, 0% N
1.
10.
100.
Volume Flow, millions of gallons per day

FIGURE 3

OPERATION AND MAINTENANCE COST ESTIMATES FOR A SEPARATE DISPERSED FLOC SYSTEM FOR NITRIFICATION DOWNSTREAM OF THE ACTIVATED SLUDGE PROCESS

DESIGN AVERAGE FLOW = 100 mgd NATIONAL AVERAGE COST, January, 1970

PROCESS COMPONENTS	Operation mh/yr	Maintenance mh/yr	Total Direct Labor mh/yr	Materials, Supplies, and Utilities $/yr
1. Nitrification Tanks (3 hr)	9,200	7,200	16,400	72,000
2. Nitrification Recycle Pumps	1,700	1,200	2,900	9,300
3. Nitrification Sedimentation	6,600	3,400	10,000	5,000
Total Man-hours per Year			29,300	
Total Annual Dollars for Materials, Supplies, and Utilities				$86,300
Total Annual Salaries with 15% Fringe Benefits ($3.75/man-hr)				$126,356
Total Annual Dollars for Salaries and Materials, Supplies, and Utilities				$212,656
Yardwork, Laboratory, and Administrative and General @ 13.2% of Total				$28,071
TOTAL ANNUAL COST FOR OPERATION AND MAINTENANCE				$240,727
TOTAL OPERATION AND MAINTENANCE COST, CENTS/1000 GALLONS				0.66